Contents of Mammalian Biochemistry (companion text)	XIII
Preface	xv
1 The Scope of Biochemistry	1
Part One The Major Constituents of Cells	
2 The Major Chemical Constituents of Cells	13
General chemical composition	13
Water	14
Acids and bases	18
3 Proteins I	23
Functional diversity of proteins	23
General structural design	24
Amino acids	30
Peptides	38
4 Proteins II	42
General considerations of protein structure	42
Molecular weight	43
Shape of protein molecules	50
Amphoteric properties	50
Solubility	51
Spectral analysis of proteins	53
Departuration of proteins	56

# viii

5 Pro	teins III	58 <sup>3</sup>
	Primary structure	58
	Three-dimensional structure	69
6 The	: Carbohydrates	83
	General biological roles	83
	Classification	83
	Monosaccharides	84
	Biologically important monosaccharides	92
	Oligo- and polysaccharides glycoproteins	96
7 The	Lipids: Biological Amphiphiles	107
	General properties	107
	Classification	107
	The fatty acids	108
	Lipids containing glycerol	110
	Lipids not containing glycerol	115
	Lipids as amphiphiles: micelles and bilayers	120
8 The	Nucleic Acids	126
	Components of nucleic acids	126
	Structure of deoxyribonucleic acids	130
	Double-helical structure of DNA	136
	Proteins associated with DNA	149
	Structure of ribonucleic acids	151
9 <b>M</b> e	thods of Separation and Purification of Compounds from Biological	
S	ources	156
	The problems of purification	156
	Chromatography	161
	Electrophoresis	171
	Criteria of purity	174
Part Two	Catalysis	
10 Er	nzymes I	179
	General nature of enzymes	179
	Nomenclature and classification of enzymes	183
	Cofactors and coenzymes	184
	Kinetics of enzymic reactions	184
	Inhibition of enzymes	194
	Metabolic inhibitors: antimetabolites	198
	Regulation of enzymic activity	199

	IA
	Contents
11 Enzymes II	210
Substrate specificity of enzymes	210
Mechanisms of rate enhancement of chemical reactions by enzymes	212
Nature of active sites and enzymic mechanisms	220
Part Three Metabolism	
12 Introduction to Metabolism: Principles of Bioenergetics	241
Thermodynamic principles	242
Oxidation-reduction reactions	247
High-energy phosphate compounds	250
Energy requirements	255
Mechanisms regulating metabolism	258
Experimental approaches to the study of metabolism	262
13 Membranes and Subcellular Organelles	268
Functions of membranes and subcellular organelles	268
Composition of membranes	271
Structure of membranes	272
Asymmetry of membranes	278
Assembly of membranes	281
Intracellular fibrillar structures	285
14 Receptors and Transport	289
Receptors	289
Transport	302
15 Biological Oxidations I	316
Oxidative enzymes and coenzymes	317
The citric acid cycle	323
Mitochondrial structure	332
Electron transport	337
Oxidative phosphorylation	344
Mechanism of oxidative phosphorylation	348
16 Biological Oxidations II: Oxidative Enzymes, Coenzymes, and Carriers	357
Nicotinamide adenine nucleotides	358
Flavoproteins	361
Proteins containing iron-sulfur centers	364
Cytochromes	367
Oxidases, oxygenases, and hydroxylases	377
Peroxide and superoxide	381

17 Carbohydrate Metabolism I	385
Carbohydrate metabolism: an overview and some general principles	
of metabolism	385
Cellular uptake and production of glucose	389
Glycolysis	393
Anaplerosis: pyruvate and oxaloacetate metabolism	408
Gluconeogenesis	411
Regulation of glycolysis and gluconeogenesis	414
The phosphogluconate oxidative pathway	417
Some specialized pathways of carbohydrate metabolism in plants	
and microorganisms	424
18 Carbohydrate Metabolism II	428
Polysaccharides as energy reserves: glycogen	428
Glycogen metabolism	430
Glycogen synthesis	439
Blood glucose and regulation of glucose metabolism	447
Hexose interconversions	449
Biosynthesis of oligosaccharides	456
Biological roles of glycoproteins and glycolipids	463
Microbial cell walls	469
19 Carbohydrate Metabolism III	478
The chloroplast	479
Fixation of CO <sub>2</sub>	480
Carbohydrate synthesis	481
The photosynthetic process	489
20 Lipid Metabolism I Triacylglycerols	508
Intestinal absorption of lipids	508
Plasma lipoproteins and lipid transport	509
Outline of triacylglycerol metabolism	512
Lipids of the body	512
Oxidation of fatty acids	513
Synthesis of fatty acids	522
Fatty acid interconversions	529
Synthesis of triacylglycerols	532
Regulation of lipid metabolism	534
Energetic aspects of lipogenesis from carbohydrate	535
Mobilization of depot and liver lipid	536 538
The ketone bodies and ketosis	536 542
Dietary status and hepatic metabolism of fatty acids	J4 2
Metabolism of ethanol and alcoholism: relationship to lipid	543
metabolism	V 10

	xi
	Contents
21 Lipid Metabolism II	545
The phosphoglycerides Sphingolipids Glycosphingolipids Cholesterol metabolism and its controls Incorporation of amphipathic lipids in membranes	545 553 554 558 569
22 Amino Acid Metabolism I: Plants and Microorganisms Fixation of nitrogen Fixation of ammonia Fixation of sulfur Amino acid synthesis	571 571 575 578 580
23 Amino Acid Metabolism II: Mammals  Transport of amino acids Amino acids nutritionally essential for human beings Metabolic origins of nutritionally nonessential amino acids Metabolism of one carbon-compounds Metabolism of ammonia Urea synthesis: the urea cycle Overall aspects of amino acid metabolism	599 600 601 604 607 613 615
24 Amino Acid Metabolism III Synthesis of oligopeptides Detoxification: N-acylamino acids and mercapturic acids Transamidination-creatine biosynthesis Transmethylation Biosynthesis of tetrapyrroles: heme synthesis Amino acid decarboxylation Polyamines	622 622 625 627 628 631 637
25 Amino Acid Metabolism IV: Fates in Mammals Glycogenic and ketogenic amino acids Amino acid metabolism in human tissues Metabolic fates of individual amino acids	646 646 647 649
26 Metabolism of Purine and Pyrimidine Nucleotides Synthesis of purine and pyrimidine nucleotides Formation of deoxyribonucleotides Synthesis of nucleotide coenzymes Degradation of purine and pyrimidine nucleotides	672 672 681 685 688
art Four Molecular Genetics	
27 The Gene and Its Replication The gene as DNA	699 699

P

## xii

	Semiconservative replication of DNA	700
	Enzymes of DNA replication	704
	Repair of DNA	715
	Genetic recombination	719
	Modification and restriction of DNA	721
	Plasmids	722
	Isolation of genes by cloning recombinant DNA molecules constructed	
	in vitro	724
28	Gene Expression and Its Control: Prokaryotes	727
	The gene and protein synthesis	727
	Components of the translation mechanism	728
	Mechanism of translation	734
	The genetic code	739
	Transcription -	745
	Processing of RNA transcripts	749
	Colinearity of the genetic map and amino acid sequence in prokaryotes	751
	Control of protein synthesis	753
	Synthesis and cloning of genes	759
29	Gene Expression and Its Control: Eukaryotes	763
	Structure of eukaryotic chromosomes	764
	Sequence arrangements in eukaryotic DNA	766
	Transcription of eukaryotic genomes	771
	Regulation of gene expression	778
	Molecular genetics of hemoglobin	784
	The cell cycle	788
30	Viruses	791
	Virus multiplication cycle	791
	Double-stranded DNA viruses	793
	Single-stranded DNA viruses	800
	RNA viruses	802
	The interferons	810
31	Molecular Evolution	813
	Amino acid substitution and protein function	814
	Evolution and protein structure	815
	Expression of evolutionary factors	826
	Population variation and survival value	827
	Hereditary disorders of metabolism	828
T	da	835

## Contents of Mammalian Biochemistry (companion text)

#### Part One Body Fluids and Their Constituents

- 1 Blood
- 2 The Immune System
- 3 The Erythrocyte
- 4 Hemoglobin and the Chemistry of Respiration
- 5 Body Fluids, Electrolytes, and Acid-Base Balance: The Kidney

#### Part Two Specialized Tissues

- 6 Connective Tissue
- 7 The Nervous System
- 8 Muscle
- 9 The Eve
- 10 The Gastrointestinal Tract: Digestion, Absorption, Hormonal Regulation

#### Part Three Biochemistry of the Endocrine Systems

- 11 General Principles Concerning the Nature and Actions of Hormones
- 12 Mechanisms of Hormone Action
- 13 Prostaglandins and Related Agents
- 14 The Thyroid
- 15 Bond and the Hormonal Control of Calcium and Phosphate Metabolism: Parathyroid Hormone, Calcitonin, Vitamin D
- 16 The Pancreatic Islets
- 17 The Gonads
- 18 The Adrenals
- 19 The Thymus
- 20 Hypothalamus, Hypophysis, and Pineal Gland

#### Part Four Nutrition

- 21 The Major Nutrients
- 22 The Water-Soluble Vitamins
- 23 The Lipid-Soluble Vitamins

Index